Agricultural Protectionism in a Strategic Trade Policy Context: An Application to the US Cheese Market

Abstract

Using a general conjectural variations model, this paper shows that even though import tariffs may be justified where markets are imperfectly competitive, such a policy may be inferior to alternative forms of trade intervention. These results are evaluated in the context of the US cheese processing sector.

ESO - 1689

Agricultural Protectionism in a Strategic Trade Policy Context: An Application to the US Cheese Market

Steve McCorriston* and Ian M. Sheldon†

*University of Exeter, Devon, UK

†The Ohio State University, Columbus, USA

February 1990

Introduction

A significant and increasing proportion of international agricultural trade now occurs where markets are less than perfect, involving state marketing boards, multinational firms and firms involved in food processing (see McCalla, 1981, Handy and MacDonald and Elleson for discussion). However, despite this, there has only been a limited discussion by agricultural economists of the arguments put forward in the international economics literature which suggest that an active trade policy may be justified where markets are imperfectly competitive. Therefore, the aim of this paper is to assess the relevance of these theoretical developments for agricultural trade policy, with specific reference to processed food markets.

The paper is outlined as follows: Section 1 briefly reviews the arguments for active trade policy where markets are imperfectly competitive. Section 2 compares two forms of intervention, an optimal tariff and a maximum import price. The application of the theoretical results to the US processed cheese sector is presented in Section 3 whilst Section 4 provides a brief summary and conclusion.

1. Trade Policy and Imperfect Competition

The standard justification put forward for what is known as strategic trade policy is that of "rent-shifting" (see for example, Brander and Spencer, 1984, 1985, and Dixit, 1984). The basic idea is that a government can alter the nature of competition between firms for monopoly rents in imperfectly competitive markets. Hence, in a quantity-setting framework, tariffs and export subsidies can increase the welfare of importers and exporters respectively[(1)].

Whilst imperfect competition has been incorporated into agricultural trade analysis[(2)], strategic trade policy has largely been ignored, the principal exception to this being the

recent work of Thursby and Krishna and Thursby who have focussed on markets where state marketing boards are important participants in agricultural trade. This paper extends such analysis to trade in high-value food products which represent an increasingly important part of agricultural trade (Elleson). Importantly, in contrast to much of the literature which focusses on the effects of tariffs and quotas, this paper compares the welfare effects of a price control policy on imports with that of an optimal tariff.

2. Theoretical Framework

The theoretical model used follows that of Dixit (1988) and is similar to Cheng. The essential features of it are: the use of a general conjectural variations approach, where the conjectural variations parameters are left free allowing different forms of oligopolistic behaviour; firms' costs are assumed to be constant; home produced goods (subscript 1) and imported goods (subscript 2) are treated as imperfect substitutes.

Consumer surplus is given by:

(1)
$$\Gamma = f(Q_1,Q_2) - p_1Q_1 - p_2Q_2$$

where the utility function $f(Q_1,Q_2)$ is defined as:

(2)
$$f(Q_1,Q_2) = a_1Q_1 + a_2Q_2 - \frac{1}{2}(b_1Q_1^2 + b_2Q_2^2 + 2kQ_1Q_2)$$

From (1) and (2) the inverse demand functions for the home produced and imported goods can be derived:

(3)
$$p_1 = a_1 - b_1Q_1 - kQ_2$$

(4)

$$p_2 = a_2 - kQ_1 - b_2Q_2$$

where all parameters are positive, $b_1b_2 - k^2 > 0$ since the products are imperfect substitutes, p_1 and p_2 are prices and Q_1 and Q_2 are quantities.

On the supply side, there are n_i firms in the home and foreign economies. Profits for a representative firm in each country are given by:

(5)

$$\pi_1 = (p_1 - c_1)q_1 - f_1$$

(6)

$$\pi_2 = (p_2 - c_2 - t)q_2 - f_2$$

where prices and quantities are as defined above, c_i and f_i are marginal and fixed costs respectively and t is a tariff imposed on imports.

As noted earlier, the model is one where firms' reactions to one another are treated as a Nash equilibrium with conjectural variations. The conjectural variations parameters are derived from the first-order conditions of the respective profits functions:

(7)

$$p_1 - c_1 + q_1 dp_1/dq_1 = 0$$

(8)

$$p_2 - c_2 - t + q_2 dp_2/dq_2 = 0$$

where dp_i/dq_i is the conjectural variations parameter, i.e. the firm's expectation of how market prices will vary with changes in its output. Therefore, if a representative firm plays Cournot, it believes rival firms will not change output in response to a change in q_i, hence $dp_i/dq_i = -b_i$, the slope of the inverse demand function. If the market were perfectly competitive, a change in one firm's output would have no effect on market price, i.e. $dp_i/dq_i = 0$.

Aggregating over the n_i firms generates:

(9)

$$p_1 - c_1 + Q_1V_1 = 0$$

(10)

$$p_2 - c_2 - t + Q_2V_2 = 0$$

where V_i is the aggregate conjectural variations parameter. Thus, for Cournot behaviour, $V_i = -b_i/n_i$ and as n_i increases, the more competitive the Cournot outcome becomes. In the limit $V_i = 0$, i.e. perfect competition[3].

Equilibrium prices and quantities in the model are obtained by combining (3) and (4) with (9) and (10), the explicit solutions for quantities being:

(11)

$$\begin{bmatrix} Q_1 \\ Q_2 \end{bmatrix} = \frac{1}{\Delta'} \begin{bmatrix} b_2 + V_2 & -k \\ -k & b_1+V_1 \end{bmatrix} \begin{bmatrix} a_1 - c_1 \\ a_2 - c_2 - t \end{bmatrix}$$

where $\Delta' = (b_1 + V_1)(b_2 + V_2) - k^2 = (\beta_1 \beta_2 - k^2)$.

The government's aim is to maximise domestic economic welfare which is defined as the sum of consumer surplus, domestic firms' profits and government revenue as given by:

(12)

$$W = \Gamma + Q_1(p_1 - c_1) + tQ_2$$

which, substituting for Γ from (1), can be re-written as:

(13)

$$W = f(Q_1,Q_2) - c_1Q_1 - p_2Q_2 + tQ_2$$

It is assumed that government intervention affects neither the demand parameters nor firms' conjectures.

(a) Optimal Tariff Policy

If a tariff is the main trade policy instrument available to the government, the optimal value for such a policy is derived by maximising (13) with respect to t. Using (2) and (10), the first-order condition for welfare maximisation is:

(14)

$$\frac{\delta W}{\delta t} = \frac{V_2(a_2 - b_2Q_2 - kQ_1) + (p_2 - c_2)}{(1 - V_2)}$$

As Q_1 and Q_2 are endogenous, (14) can be solved by substituting in (11) to give:

(15)

$$t = \frac{a_2 V_2 - \frac{V_2 b_2}{\Delta'}[\beta_1(a_2 - c_2) - k(a_1 - c_1)] - \frac{V_2 k}{\Delta'}[\beta_2(a_1 - c_1) - k(a_2 - c_2)] + (p_2 - c_2)}{1 - V_2}$$

Clearly the tariff is a function of the demand parameters, relative costs and the degree of imperfect competition.

(b) Optimal Import Price Policy

Most discussion of strategic trade policy has focussed on a comparison of the effects of tariffs and quotas. However, this paper considers an alternative policy instrument which involves the government choosing an import price that maximises domestic welfare, i.e. (13) is maximised with respect to p_2. Using (2) and (10), the first-order condition is:

(16)

$$\frac{\delta W}{\delta p_2} = -(a_2 - b_2 Q_2 - k Q_1) - (p_2 - c_2)/V_2$$

Again, given that Q_1 and Q_2 are endogenous, (16) can be solved by substituting in (11) to give:

(17)

$$\bar{p}_2 = -a_2 V_2 + \frac{b_2 V_2}{\Delta'}[\beta_1(a_2 - c_2) - k(a_1 - c_1)] + \frac{V_2 k}{\Delta'}[\beta_2(a_1 - c_1) - k(a_2 - c_2)] + c_2$$

where $\bar{p}_2$ is the optimal import price which is a function of the demand parameters, relative costs and conjectural variations. In effect, it represents the **maximum** price at which imported goods can enter the domestic market.

3. Trade Policies for the US Cheese Processing Sector

These theoretical results can be evaluated empirically by using a computable partial equilibrium model originally suggested by Dixit (1987a). Since details of this model can be found elsewhere, the main details have been confined to an Appendix. The essence of this

technique, of which there are only a few examples, is to calibrate the model with data from external empirical sources such that the parameters of the demand system are consistent with equilibrium in a given period.

Focussing on the US cheese processing sector, the effects of optimal trade policies can be examined. As there are a large number of varieties in this grouping, the analysis is confined to US imports of blue-vein cheese from the EC. This type of cheese was chosen for several reasons: first, it is a sector where there is a clear demand for government support, the US having protected it with import quotas since 1951 (see Hornig for a useful discussion); second, the US and EC cheese processing sectors are to varying degrees imperfectly competitive (see Hornig); third, blue-vein cheese is largely exported from the EC by private firms compared to other cheese varieties which tend to be exported by marketing boards and other organisations; and finally, most US imports of blue-vein cheese originate from the EC.

Using price, quantity and elasticity data for blue-vein cheese, the model was calibrated for the years 1980 and 1985. Since import quotas currently affect the US cheese market, the model was initially used to simulate the effects on prices and quantities of liberalisation in the world dairy market, the estimated price changes being based on those of Tyers and Anderson. The model was then re-calibrated such that the parameters were consistent with these hypothetical free market values. Details of the data used are given in the Appendix.

Table 1 Optimal Tariffs and Maximum Import Prices ($/lb)

	1980	1985
Optimal Tariff	0.12	0.16
Maximum Import Price	1.39	1.87

Given the calibration, values for the optimal tariff and maximum import price were derived for 1980 and 1985, the values being shown in Table 1. In accordance with the theoretical analysis, there appears to be some justification for the use of a tariff on US imports from the EC given the structural characteristics of the two markets. For both 1980 and 1985, the tariff represents 8 per cent of the original import price, whilst, in contrast, the maximum import price is 8 per cent less than the original import price. Essentially, since the exporter is assumed to have a price-cost markup (see Appendix), the optimal tariff is shifting rents from EC firms to the US economy. In the case of the maximum import price, the US government is forcing EC firms to forego their rents on exports by ensuring that the import price is equal to their costs of production, i.e. EC firms are being forced to play competitively.

In order to evaluate the effects of these policies on economic welfare, new equilibrium prices and quantities for the US cheese market were derived using (3), (4), (9) and (10), the welfare effects being described in Table 2. With reference to the optimal tariff, it is evident that this only marginally improves economic welfare in the US cheese sector in both periods. Relative to original levels of welfare, tariffs raise welfare by 0.2 and 0.3 per cent in 1980 and 1985 respectively. Such small gains from tariffs are consistent with Dixit's (1987a) study of the US car market and Baldwin and Krugman's study of semi-conductors. Therefore, the effect of optimal tariffs is largely distributional, consumers losing

from the policy whilst domestic firms' profits and government revenue increases.

In contrast, the maximum import price appears to be a superior policy instrument, the gains in welfare being larger than those from the optimal tariff. For 1980 and 1985 respectively, welfare increases by 2.6 percent and 3.2 per cent relative to original welfare levels. Again there are distributional effects, although in this case, the gains to consumers from lower priced imports outweigh the losses in domestic firms' profits[4].

Table 2 Welfare Effects of Optimal Trade Policies ($m)

	1980			1985		
	Original Welfare	t	p_2	Original Welfare	t	p_2
Consumer Surplus	26.50	25.87	27.38	32.96	31.97	34.26
Domestic Firms' Profits	4.39	4.42	4.32	5.27	5.36	5.18
Government Revenue	--	0.68	--	--	1.02	--
Total Welfare	30.89	30.97	31.70	38.23	38.35	39.44

The intuition as to why maximum import prices are superior is as follows: the optimal tariff restricts competition in the domestic market, the increase in firms' profits and government revenue (marginally) outweighing the losses to consumers; however, the maximum import price forces foreign firms to sell at prices near to cost which, in effect, imposes competitive discipline on domestic firms, and results in consumer gains outweighing the losses to domestic firms' profits. In general, the policy of setting a maximum import price raises a question against the standard strategic trade policy argument since it suggests that, under certain circumstances, making the market more competitive is better than making it less competitive.

4. Summary and Conclusion

The theory of strategic trade policy suggests that there may be a normative justification for active trade policy where markets are imperfectly competitive. This may have important implications for agricultural trade where a growing proportion is conducted by state organisations, marketing boards and large-scale food processors. In this context, this paper has considered the welfare effects of implementing tariffs and maximum import prices for the US cheese processing sector with reference to imports from the EC. The main conclusions to be drawn from the analysis are that tariffs only marginally increase economic welfare, whilst the superior policy of a maximum import price would enhance competitive discipline in the market.

Clearly there is considerable scope for further analysis of these arguments with respect to agricultural trade. First, the theoretical model needs to be extended to deal more explicitly with the characteristics of imperfectly competitive agricultural markets. Second, detailed empirical analysis is required to test these theories based on improved model specification, including the use of econometric models and better quality data.

Notes

1. Eaton and Grossman show that the choice of policy by the exporter is sensitive to whether the strategic variable of firms is price or quantity. In addition, further qualifications to the original analysis of Brander and Spencer have been made (see Dixit, 1987b, and Helpman and Krugman).

2. For example, the role of government interactions in trade has been discussed by McCalla (1966) and Schmitz *et al.* amongst others and the presence of intermediaries such as marketing boards has been highlighted by Just *et al.* and Markusen.

3. The V_i can be calculated for a particular market equilibrium given data on prices, quantities and costs.

4. It may be argued that these results will be sensitive to the data used to calibrate the model. In order to test this, a lower value for the elasticity of demand and a higher value for the elasticity of substitution between home and imported goods were chosen. Apart from slight changes in the magnitude of welfare values, the overall conclusions of the main results hold; optimal tariffs only increase welfare marginally, their main impact being distributional, whilst maximum import prices are a superior means of enhancing welfare.

Appendix

In order to derive the optimal trade policies and simulate their effects, it is necessary to have estimates of the parameters in the demand system. This is done by taking some of the parameter estimates from external empirical sources. The remainder are calculated by calibrating the theoretical model such that the parameters are consistent with equilibrium in the market in a given period. Focussing on the demand functions (A1) and (A2), there are five unknown parameters, A_1, A_2, B_1, B_2 and K. Since actual prices and quantities give two relations between them, three further relations are required to solve the system.

(A1)

$$Q_1 = A_1 - b_1 p_1 + K p_2$$

(A2)

$$Q_2 = A_2 + K p_1 - B_2 p_2$$

Following Dixit (1987a), expressions for the price elasticity of demand and elasticity of substitution can be derived and then set equal to empirically observed values. In the case of the price elasticity of demand, since the products of the dominant firms and importers are being treated as imperfect substitutes, it is interpreted as being the effect of an equiproportionate rise in the price of the two products on total expenditure Q. Therefore, letting $p_1 = P_1^0 P$ and $p_2 = P_2^0 P$, where P_1^0 and P_2^0 are initial prices and P is the proportional change factor, aggregate expenditure can be written as:

(A3)

$$Q = P_1^0 Q_1 + P_2^0 Q_2$$

Given that in the calibration p_1 and p_2 are the initial prices, and substituting equations (1) and (2) into (A3), the aggregate expenditure index can be re-written as:

(A4)

$$Q = p_1 A_1 + p_2 A_2 - (B_1 p_1^2 + B_2 p_2^2 - 2K p_1 p_2) P$$

The total market elasticity of demand ε, is then defined and evaluated at the initial point where the proportional change factor P equals one. By differentiating (A2) with respect to P, and multiplying by P/Q, the elasticity is given as:

(A5)

$$\varepsilon = - \frac{B_1 p_1^2 + B_2 p_2^2 - 2K p_1 p_2}{Q}$$

The elasticity of substitution would normally be defined as:

(A6)

$$\sigma = d\log(Q_1/Q_2)/d\log(p_1/p_2)$$

which gives a fourth relation between the parameters when set equal to the observed value for σ. However, as Dixit (1987a) notes, (A1) and (A2) in general define the ratio Q_1/Q_2 as a function of the vector (p_1,p_2) and not in terms of the ratio p_1/p_2. In order for Q_1/Q_2 to be a function of p_1/p_2, at least locally, then the parameters must satisfy the following relation:

(A7)

$$p_1(A_1K + A_2B_1) - p_2(A_2K + A_1B_2)$$

which implies homotheticity of the utility function. Given the definition of σ in (A6) and using (A1), (A2) and (A7), the final expression for the elasticity of substitution can be derived as:

(A8)

$$\sigma = \frac{\frac{p_1}{p_2}(B_1B_2 - K^2)}{(B_1\frac{p_1}{p_2} - K)(B_2 - K\frac{p_1}{p_2})}$$

Given this procedure, the model was calibrated for the years 1980 and 1985. Price and quantity data were derived from USDA Dairy Market Statistics, USDA Dairy Products and USDA Foriegn Agricultural Trade. The value of ε for blue-vein cheese was derived from Anderson. No US estimate exists for σ, so a value of 1.6 was used based on an Australian estimate made by Higgs. It should be noted that sensitivity analysis was conducted with different values of the elasticity parameters (see note 4). No precise data for costs were available, consequently, costs for both the US and EC were assumed to be 8 per cent below wholesale prices which accords with the level of the price-cost mark-up reported by Hornig.

References

Anderson, J. E. (1985) "The Inefficiency of Quotas: The Cheese Case", **American Economic Review, 75,** 178-191.

Baldwin, R. E. and Krugman, P. (1987) "Market Access and International Competition: A Study of 16K Random Access Memories", in **Empirical Methods in International Trade**, edited by R. Feenstra, MIT press, Cambridge , MA.

Brander, J. A. and Spencer, B. J. (1984) "Tariff Protection and Imperfect Competition", in **Monopolistic Competition and International Trade**, edited by H. Kierzkowski, Basil Blackwell, Oxford.

Brander, J. A. and Spencer, B. J. (1985) "Export Subsidies and International Market Share Rivalry", **Journal of International Economics, 18,** 83-100.

Cheng, L. K. (1988) "Assisting Domestic Industries Under International Oligopoly: The Relevance of the Nature of Competition to Optimal Policies", **American Economic Review, 78,** 746-758.

Dixit, A. (1984) "International Trade Policy for Oligopolistic Industries", **Economic Journal, 94,** Supplement, 1-16.

Dixit, A. (1987a) "Optimal Trade and Industrial Policy for the US Automobile Industry", in **Empirical Methods in International Trade**, edited by R. Feenstra, MIT Press, Cambridge, MA.

Dixit, A. (1987b) "Strategic Aspects of Trade Policy", in **Advances in Economic Theory: Fifth World Congress**, edited by T. F. Bewley, Cambridge University Press, Cambridge.

Dixit, A. (1988) "Anti-Dumping and Countervailing Duties under Oligopoly", **European Economic Review, 32,** 55-68.

Eaton, J. and Grossman, G. M. (1986) "Optimal Trade and Industrial Policy under Oligopoly", **Quarterly Journal of Economics, 100,** 383-406.

Elleson, R. (1988) "High Value Products: Growing US and EC Competition in Third Markets", **Western Europe Agriculture and Trade Report**, USDA ERS.

Handy, C. and MacDonald, J. (1989) "Multinational Structures and Strategies of US Food Firms", **American Journal of Agricultural Economics, 71,** 1246-1254.

Helpman, E. and Krugman, P. (1989) **Trade Policy and Market Structure**, MIT Press, Cambridge, MA.

Higgs, P. J. (1986) **Adaptation and Survival in Australian Agriculture**, Oxford University Press, Oxford.

Hornig, E. (1987) **The Political Economy of US Cheese Import Quotas: The Creation and Capture of Quota Rents and Subsidies**, unpublished PhD thesis, Cornell University.

Just, H., Schmitz, A. and Zilberman, D. (1979) "Price Controls and Optimal Export Policies under Alternative Market Structures", **American Economic Review, 69**, 706-715.

Krishna, K. and Thursby, M. (1988) "Optimal Policies with Strategic Distortions", **NBER Working Paper, 2527**, Cambridge, MA.

Markusen, J. R. (1984) "The Welfare and Allocative Effects of Export Taxes versus Marketing Board", **Journal of Development Economics, 14**, 19-36.

McCalla, A. F. (1966) "A Duopoly Model of World Wheat Pricing", **Journal of Farm Economics, 48**, 711-727.

McCalla, A. F. (1981) "Structural and Market Power Considerations in Imperfect Agricultural Markets" in **Imperfect Markets and Agricultural Trade**, edited by A. F. McCalla and T. Josling, Allanheld, Osmun, Montclair, NJ.

Schmitz, A., McCalla, A. F., Mitchell, D. O. and Carter, C. (1981) **Grain Export Cartels**, Ballinger, Cambridge, MA.

Thursby, M. (1988) "Strategic Models, Market Structure and State Trading: An Application to Agriculture" in **Trade Policy Issues and Empirical Analysis**, edited by R. E. Baldwin, NBER, University of Chicago Press, Chicago.

Tyers, T. and Anderson, K. (1988) "Liberalising OECD Agricultural Policies in the Uruguay Round: Effects on Trade and Welfare", **Journal of Agricultural Economics, 39**, 197-216.